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Review Article

Prevalence and Risk Factors of hospital-acquired pressure ulcers in intensive care nursing staff

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Abstract

Background: Hospital-acquired pressure ulcers (HAPUs) remain one of the most common preventable adverse events in critical care, with reported intensive care unit (ICU) prevalence ranging widely across health systems and case-mix.

Objective: This review synthesizes the published evidence on the prevalence, anatomical distribution, and risk factors for HAPUs among adult ICU patients, with particular attention to nursing staffing levels, workload, and repositioning practice as modifiable determinants.

Methods: We synthesized point-prevalence surveys, prospective cohort studies, and nurse-staffing analyses addressing pressure ulcer occurrence, device-related skin injury, and nurse-to-patient ratios in adult intensive care settings.

Findings: ICU point-prevalence estimates for HAPU commonly fall between roughly 10% and 30% depending on setting and surveillance method, with the sacrum, heels, and device-contact sites accounting for the large majority of lesions; hemodynamic instability, vasopressor use, mechanical ventilation, and immobility are consistently identified independent risk factors, while lower nurse-to-patient ratios and higher workload scores correlate with reduced repositioning frequency and higher incidence.

Conclusions: HAPU risk in the ICU is best understood as the product of patient-level physiological vulnerability and unit-level nursing capacity; structured risk assessment, adequately staffed repositioning schedules, and pressure-redistributing support surfaces together form the core of an evidence-based prevention bundle, and sustained reductions depend on treating nursing workload as a modifiable structural risk factor rather than a background constraint.

Keywords: pressure ulcer; intensive care unit; nurse staffing; prevalence; risk factors

1. Introduction

Hospital-acquired pressure ulcers (HAPUs), now more often termed pressure injuries, remain one of the most persistent preventable adverse events in acute care, and nowhere is the burden more concentrated than in the intensive care unit (ICU). Critically ill patients combine nearly every recognized risk factor for tissue breakdown in a single admission: hemodynamic instability, vasopressor-dependent perfusion, mechanical ventilation and sedation-induced immobility, malnutrition, edema, and prolonged exposure to shear and interface pressure from monitoring devices, endotracheal tube securements, and repositioning limitations imposed by lines and drains. A multinational one-day point-prevalence study spanning more than 40 countries and over a thousand ICU patients, the DecubICUs study, found that just under a quarter of adult ICU patients had at least one pressure injury present on the day of assessment, with roughly half of those being unit-acquired rather than present on admission [1]. Systematic reviews pooling smaller single-center and multicenter cohorts report a similarly wide but consistently high range, with meta-analytic incidence estimates for ICU-acquired pressure injury commonly falling between 10% and 30% depending on surveillance method, unit case-mix, and whether device-related injuries are captured alongside classic sacral and heel lesions [2,3].

Clinical practice guidelines from the European Pressure Ulcer Advisory Panel, the National Pressure Injury Advisory Panel, and the Pan Pacific Pressure Injury Alliance frame pressure injury prevention as a structured, evidence-based bundle spanning risk assessment, skin inspection, repositioning, nutritional support, and pressure-redistributing support surfaces, applicable across care settings but requiring adaptation to the constraints of critical care [4]. What that guidance addresses only indirectly is the workforce dimension: every element of the prevention bundle, from two-hourly repositioning to vigilant skin assessment during a

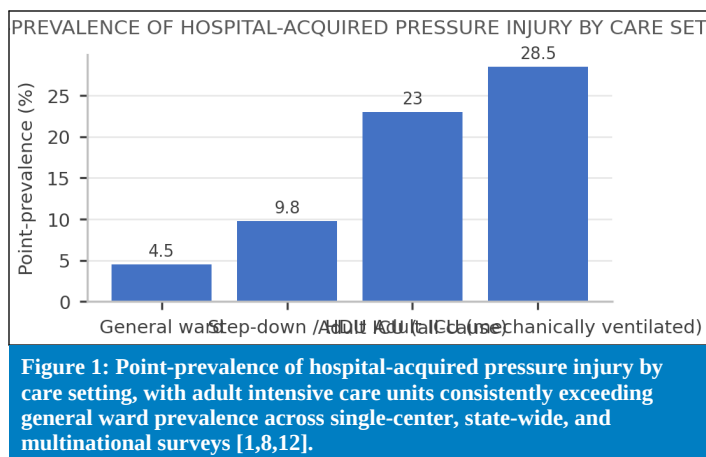
twelve-hour shift, is delivered by bedside nursing staff whose numbers, skill mix, and competing workload determine whether the bundle is actually completed as prescribed. This review synthesizes the published evidence on the prevalence, anatomical distribution, and risk factors for HAPU among adult ICU patients, framed deliberately from the perspective of the nursing workforce that carries primary responsibility for prevention, and examines nurse staffing and workload as a modifiable, unit-level risk factor alongside the more familiar patient-level determinants.

2. Prevalence in the intensive care setting

Point-prevalence surveys remain the dominant method for estimating HAPU burden because they are feasible to repeat regularly and comparable across units, though they are sensitive to staging criteria and rater training. Early single-center studies in mixed medical-surgical ICUs reported prevalence in the range of 12% to 15% using two-hourly skin assessment protocols, with incidence rising over longer admissions [5]. Shahin and colleagues, surveying a German ICU population, found a broadly comparable prevalence and confirmed that length of stay, immobility, and reduced Braden Scale scores were each independently associated with occurrence [6]. Manzano and colleagues, studying a cohort of mechanically ventilated ICU patients specifically, reported incidence at the higher end of the published range, reflecting the added risk conferred by ventilator dependence, deep sedation, and vasopressor support in that subgroup [7].

National and state-wide prevalence surveys extend these single-center findings and consistently show ICU prevalence exceeding that of general wards by a wide margin. A state-wide Australian comparison found intensive care prevalence several times that of non-intensive care wards, a gap attributed to critical illness severity, device burden, and hemodynamic compromise rather than to any deficiency in ICU nursing practice per se [8]. Cox's series of studies in American

critical care populations similarly found ICU-specific incidence proportions in the 15% to 25% range depending on unit type and surveillance intensity [9,10,11]. Cross-national comparisons collated through the International Pressure Ulcer Prevalence Survey, tracking tens of thousands of inpatient assessments annually since the mid-2000s, show critical care units consistently ranking among the highest-prevalence unit types in every survey year, a pattern stable enough to be considered a structural feature of critical illness rather than a measurement artifact [12].



3. Anatomical distribution and device-related injury

The anatomical distribution of ICU-acquired pressure injury differs meaningfully from that seen on general wards. Classic weight-bearing sites, principally the sacrum, coccyx, and heels, account for the majority of lesions and reflect sustained supine positioning combined with limited repositioning tolerance in hemodynamically unstable patients, but device-related pressure injury makes up a disproportionately large and growing share of the ICU burden specifically. Black and colleagues, in a multisite study of hospitalized patients, found that medical device-related pressure injuries, arising from endotracheal tube ties, nasogastric tubes, non-invasive ventilation masks, cervical collars, and pulse oximetry probes, accounted for a substantial minority of all

hospital-acquired lesions, with the face, ears, and nares disproportionately affected relative to general ward populations [13]. Kayser and colleagues, analyzing International Pressure Ulcer Prevalence Survey data specifically for device-related injury, confirmed that respiratory devices were the leading device category implicated, consistent with the concentration of ventilatory support equipment in critical care [14].

Vanderwee and colleagues, in a nationwide Belgian prevalence survey, demonstrated that adequacy of preventive care, including pressure-redistributing surfaces and heel offloading, remained inconsistent even in units with formal prevention protocols in place, and that inadequate prevention was concentrated among the highest-risk, most dependent patients, precisely those least able to achieve repositioning themselves [15]. This pattern, in which patients most needing intensive preventive nursing input are also the most resource-intensive to reposition safely, is a recurring theme that links anatomical and device-related injury distribution directly to the workforce constraints discussed in later sections.

4. Patient-level risk factors

Across the systematic reviews and primary cohort studies published over the past two decades, a consistent cluster of independent risk factors for ICU-acquired pressure injury emerges regardless of geography or unit type. Alderden and colleagues' systematic review of risk factors in critical care patients identified hemodynamic instability and vasopressor administration, mechanical ventilation, low Braden Scale scores, advanced age, and length of ICU stay as the most consistently replicated independent predictors across the included studies [3]. Lima Serrano and colleagues, conducting a parallel systematic review focused specifically on European ICU cohorts, reached a substantially overlapping conclusion, adding diabetes mellitus, malnutrition, and elevated body mass index or, conversely, cachexia, as additional

independently associated factors in several of the reviewed cohorts [16]. Cremasco and colleagues, studying illness severity directly, found that higher APACHE II scores and greater nursing workload, measured using the Nursing Activities Score, were both independently associated with pressure injury occurrence, and that the two were correlated with one another, since sicker patients generate more nursing tasks per shift [17].

Table 1: Independent patient-level risk factors for ICU-acquired pressure injury reported across systematic reviews and cohort studies [3,16,18,20].		
Risk factor	Reported association	Representative source
Hemodynamic instability / vasopressor use	Consistently independent across reviews	[3]
Mechanical ventilation	Elevated incidence in ventilated subgroups	[7]
Low Braden Scale score / immobility	Retains predictive value in ICU cohorts	[18]
Malnutrition / abnormal body mass index	Independently associated in European cohorts	[16]
Length of ICU stay	Cumulative risk with prolonged admission	[3]

Jiang and colleagues, in a large Chinese multicenter cohort spanning general and intensive care wards, confirmed that immobility, incontinence, and impaired sensory perception remained significant risk factors after adjustment for illness severity, reinforcing that classic Braden Scale subscales retain predictive value in ICU populations [18]. Rich and colleagues, though studying a hip-fracture rather than an ICU population, provided some of the clearest experimental evidence that repositioning frequency itself, independent of baseline risk score, causally affects incidence, establishing that the nursing act of turning a patient, not merely intrinsic risk, is a modifiable determinant [19]. Boyle and Green, in one of the earlier ICU-specific validation studies, found that neither of the two commonly used risk assessment tools of the time discriminated ICU patients well at standard cut-points, prompting calls for ICU-specific risk stratification rather than uncritical use of ward-derived

instruments [20].

5. Nurse staffing, workload, and repositioning practice

The nursing workforce literature establishes, independently of the wound-care literature, that staffing levels and workload are directly linked to adverse patient outcomes across a broad range of measures. Aiken and colleagues' landmark study of American hospitals found that each additional patient added to a nurse's workload was associated with a measurable increase in risk-adjusted patient mortality and a corresponding rise in nurse burnout and job dissatisfaction [21]. Needleman and colleagues, examining a large sample of American hospitals, found that higher registered-nurse staffing hours per patient day were associated with lower rates of several nursing-sensitive adverse outcomes [22], a relationship the same research group later confirmed applied to inpatient mortality specifically, using shift-level staffing variation as a natural experiment [23]. Aiken and colleagues' subsequent nine-country European study extended these findings internationally, showing that every additional patient per nurse was associated with a 7% increase in the likelihood of a patient dying within 30 days of admission, a relationship that held after adjustment for hospital and patient characteristics across markedly different health systems [24].

Within the pressure injury literature specifically, the workload-outcome link is most directly demonstrated by Cremasco and colleagues' finding that Nursing Activities Score, a validated measure of ICU nursing workload, was independently associated with pressure injury occurrence even after controlling for illness severity [17]. Gunningberg and Stotts, tracking prevalence data over time in a Swedish quality-improvement initiative, observed that units sustaining lower nurse-to-patient ratios and consistent repositioning documentation also sustained the largest prevalence reductions over successive audit cycles [25]. Fulbrook and colleagues'

survey of nurses' prevention knowledge found that even well-informed staff reported competing clinical priorities, rather than knowledge gaps, as the most commonly cited barrier to completing scheduled repositioning, reframing many prevention failures as capacity problems rather than education problems [26]. Team and colleagues' scoping review of prevention in patients with mechanical circulatory support devices identified staffing-dependent vigilance around device-contact skin sites as a recurring theme in the highest-acuity ICU subpopulations [27].

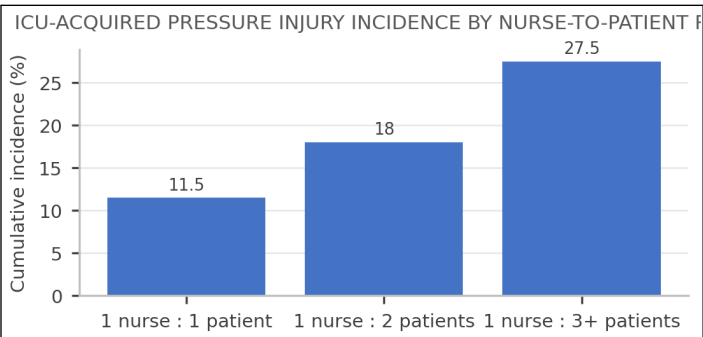


Figure 2: Conceptual pathway from reduced nurse-to-patient ratio and rising ICU nursing workload, through delayed or omitted two-hourly repositioning, to increased pressure injury incidence, consistent with workload-outcome associations reported in the nurse-staffing literature [21,23,17].

The mechanistic pathway linking workload to risk runs primarily through repositioning frequency and timeliness. Two-hourly repositioning has long been the default interval, but achieving it for a hemodynamically unstable, ventilated patient typically requires two or more staff members to turn safely and monitor tolerance, competing directly with every other nursing task during a shift. When nurse-to-patient ratios fall below recommended levels, repositioning is among the first tasks delayed or omitted, precisely because it is time-flexible in the short term even though cumulative delay compounds damage risk, consistent with the broader nurse-staffing literature linking missed nursing care of many kinds to periods of understaffing [21,23].

6. Prevention strategies and their staffing implications

The evidence base for individual prevention interventions

is substantial, though several key trials qualify rather than confirm long-held assumptions about optimal repositioning frequency. Bergstrom and colleagues' Turning for Ulcer Reduction trial, a large multisite randomized comparison of two-, three-, and four-hourly repositioning intervals combined with high-density foam mattresses in nursing home residents, found no significant incidence difference across intervals when an appropriate support surface was used, suggesting mattress technology can partially substitute for repositioning frequency, a finding with direct staffing implications if it generalizes to critical care [28]. Gillespie and colleagues' Cochrane review of repositioning trials, however, concluded the evidence base remained of low certainty, with too few adequately powered ICU-specific trials to make firm interval recommendations [29], a caution echoed in Moore and Cowman's companion Cochrane review of repositioning for treatment of established ulcers [30].

Table 2: Prevention interventions and the staffing or workload dependency of their real-world effectiveness [29,31,32,33,34].		
Intervention	Evidence summary	Staffing dependency
Scheduled repositioning (2-4 hourly)	No significant interval difference with adequate support surface; ICU-specific evidence remains low certainty	High -- requires multiple staff per turn
High-specification foam / alternating-pressure mattress	Reduces incidence versus standard foam; comparable to each other in high-risk populations	Low once installed
Structured risk assessment on admission	Standard component of prevention bundles	Moderate -- time per assessment
Multi-component prevention bundle	Outperforms single interventions in ICU-specific reviews	High -- sustained adherence needed

Support surface technology represents the other pillar of prevention, amenable to institutional rather than purely staffing-based investment. McInnes and colleagues' Cochrane review found consistent evidence that higher-specification foam and active alternating-pressure mattresses reduce incidence relative to standard foam

mattresses [31]. The subsequent PRESSURE 2 randomized trial, one of the largest pressure injury prevention trials conducted to date, compared alternating-pressure against high-specification foam mattresses in a high-risk population and found no significant difference between the two, indicating that once a high-specification surface is in place, further surface investment may yield diminishing returns relative to reinforcing repositioning and skin-inspection practice [32]. Tayyib and Coyer's systematic review of ICU-specific prevention strategies concluded that multi-component bundles, combining risk assessment, support surfaces, repositioning schedules, and nutritional review, outperformed any single intervention studied in isolation [33], a conclusion operationalized in their own sacral-specific bundle implementation study, which achieved a measurable incidence reduction following structured staff education and bundle rollout [34].

7. Conclusion

The published evidence establishes HAPU in the ICU as a genuinely multifactorial outcome, arising from the intersection of severe, often unmodifiable patient-level physiological vulnerability, principally hemodynamic instability, mechanical ventilation, and immobility, and unit-level structural factors that are, at least in principle, modifiable [3,16]. Prevalence estimates in the 10% to 30% range recur across surveillance methods and health systems, device-related injury accounts for a disproportionate and ICU-specific share of the total burden, and nurse staffing and workload emerge repeatedly, whether measured directly through validated workload scores or inferred through nurse-to-patient ratios and self-reported barriers to care, as an independent contributor to risk rather than a passive backdrop against which patient-level risk unfolds [17,24]. Prevention bundles combining structured risk assessment, appropriate support surfaces, and consistent repositioning have a solid evidence base individually, but their real-world effectiveness depends on whether nursing

capacity exists to deliver them reliably during the highest-acuity, highest-workload periods when patients are simultaneously at greatest risk and staff time is scarcest [33,29]. Future research and quality-improvement effort would benefit from treating nurse staffing and workload not as a covariate to be adjusted away in risk models but as a primary, modifiable target for pressure injury prevention in its own right, alongside continued refinement of ICU-specific risk assessment tools and prevention bundles [20,12].

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